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Experimental Investigation of the Compressible Richtmyer-Meshkov Instability from a Broad-Spectrum, Multi-mode Initial Perturbation*

(Key Letter A)

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We report on experiments using the Nova laser to study the non-linear evolution of the compressible Richtmyer-Meshkov instability. In these experiments, a millimeter-scale shock tube containing plastic (1.22 g/cc) and low-density carbon foam (0.1 g/cc) is attached to a laser-heated hohlraum. X-rays from the hohlraum launch a shock wave (~Mach 20) into the plastic, down the tube and across the plastic/foam interface into the foam. The interface between the two materials is perturbed by a broad-spectrum, multimode initial perturbation machined into the plastic side. The perturbation consists of one hundred 1 μm amplitude sine waves linearly spaced in wavelength between 10 and 100 microns, with each mode having a randomly-generated phase. The surface is characterized with high-magnification scanning electron microscopy.

Passage of the shock wave across the perturbed interface initiates the Richtmyer-Meshkov instability. The ensuing growth of the mixing layer is diagnosed using side-on radiography. The results from this multimode, broad spectrum initial perturbation are compared with results from previous single-mode perturbation experiments [1,2] as well as theoretical predictions utilizing two-phase flow and scaling-law models [3]. Since the form of the initial multimode perturbation of the interface is controlled and known quantitatively both in physical space as well as Fourier space, theoretical and numerical models used to describe the present experimental results have well defined initial conditions. The effect of mode distribution on the growth of the mixing region is also investigated.

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2. T. A. Peyser et al., Proc. of 5th Int. Workshop on Phys. of Compressible Turb. Mixing, Stony Brook, NY USA 1995 (in press).
3. U. Alon et al., Phys. Rev. Letters, 72 (1994) 2867.

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